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Increased incidence of coronary heart disease associated with "double burden" in a cohort of Italian women

Abstract

Objective of this study was to assess the risk of coronary heart disease (CHD) associated with the combination of employment status and child care among women of working age, also examining the sex of the offspring. Only two previous studies investigated the effect of double burden on CHD, observing an increased risk among employed women with high domestic burden or providing child care, although the relative risks were marginally or not significant.

The study population was composed of all women 25-50 years old at 2001 census, living in Turin in families composed only by individuals or couples, with or without children (N=109,358). Subjects were followed up during 2002-2010 for CHD incidence and mortality through record-linkage of the cohort with the local archives of mortality and hospital admissions. CHD risk was estimated by multivariate Poisson regression models.

Among employed women, CHD risk increased significantly by 29% for each child in the household (IRR=1.29) and by 39% for each son (IRR=1.39), whereas no association with the presence of children was found among non-employed women or among employed women with daughters. When categorized, the presence of two or more sons significantly increased CHD risk among employed women (IRR=2.23), compared to those without children.

The study found a significant increase in CHD risk associated with the presence of two or more sons in the household, but not daughters, among employed women. This is a new

finding, which should be confirmed in other studies, conducted also in countries where the division of domestic duties between males and females is more balanced, such as the European Nordic countries.

Keywords

coronary heart disease, double burden, epidemiology, employment, women, children

1. Introduction

During the last decades, participation of women in the labor market has greatly increased in developed countries (Jaumotte, 2003). From 1977 to nowadays employment rate in Italy has increased by 17%, mainly as a direct consequence of the growth among women, who passed from 31.5% to 41.3% of the total employed population (ISTAT, 2013). In contrast with these radical changes in women's labor market participation, women continue to carry out most domestic work and child care, and such an unequal division of domestic activities between women and men overburdens employed women (Gershuny, 2000; Anxo et al., 2011). From the Italian Multipurpose Survey on Time Use, carried out in 2002-2003, it was found that domestic work was entirely accomplished by Italian women in 41% of the interviewed couples (Mencarini, 2012). In 2008, approximately 64% of the employed women in Italy was engaged in paid and domestic work activities for more than 60 hours per week overall, and in presence of children the proportion increased to 68% (ISTAT & CNEL, 2013). A recent study by the Organisation for Economic Cooperation and Development (OECD) has shown that gender differences in domestic work in Italy are the highest among the 28 EU countries, with women performing 11 hours more domestic work than men per week (OECD, 2013).

Furthermore, the Italian Survey on the Time Use 2002-2003 showed that support to mothers provided by children differs by gender, with female children more engaged in domestic work than male ones. For example, in the age group 11-17 years: 65% of daughters were engaged in domestic work, against 44% of sons; also, females devoted 44 minutes per day to domestic work, whereas sons only 22 minutes (Romano, 2012).

It has been hypothesized that the double burden posed by the combination of work and domestic activities on women may affect their health (Waldron, Weiss, & Hughes, 1998). Different theoretical approaches exist in this research field. According to the “Role Accumulation” hypothesis, multiple roles would contribute to women’s better health because they provide more sources of social and economic support, self-esteem and personal satisfaction (Sieber, 1974; Thoits, 1983; Waldron & Jacobs, 1989; Moen, Dempster-McClain, & Williams, 1992; Lahelma, Arber, Kivelä, & Roos, 2002). On the opposite side, there are theories predicting worse health for women sustaining multiple roles. According to the “Role Strain” hypothesis (Gove, 1984; McLanahan & Adams, 1987; Ross, Mirowsky, & Goldsteen, 1990), women who combine multiple roles (wife, mother and/or worker) may experience «role overload and role conflict, which contribute to increased stress and excessive demands on time, energy and psychological resources – resulting in poorer heath» (Waldron et al., 1998). The “Negative Spillover” hypothesis is a more recent theory which assumes that the transfer of negative feelings from work to the family environment, and vice versa, may have harmful effects on health (Grzywacz & Marks, 2000).

A Swedish (Krantz & Ostergren, 2001; Krantz, Berntsson, & Lundberg, 2005) and a Finnish (Väänänen et al., 2004) cross-sectional studies have shown that women who combine child care and paid work report more psychological and physical symptoms than employed women without children. However, most longitudinal studies on the “double burden” have found either no effect or a beneficial effect of these multiple roles on women's general health or mortality (reviewed by Waldron et al., 1998).

In contrast, the only two studies investigating specifically the effect of double burden on cardiovascular health observed an increased risk among employed women with high domestic burden or providing child care (Haynes & Feinleib, 1980; Lee, Colditz, Berkman, & Kawachi, 2003). The first one is a prospective cohort study conducted by Haynes & Feinleib (1980) within the Framingham Heart Study, which found a CHD risk among employed women with children almost double than that of employed women without children. The second one, also a prospective study, was performed by Lee et al. (2003) within the Nurses' Health Study and showed that nurses caring for non-ill children 21 hours or more per week (and caring for non-ill grandchildren 9 hours or more per week) had a CHD risk 50% higher than nurses not caregiving. In support of these results, Brisson et al. (1999) observed a significantly higher systolic (SBP) and diastolic blood pressure (DBP) in white-collar women reporting large family responsibilities, but only in presence of exposure to high «job strain», defined according to the demand-control model (Karasek, 1979).

Considering the scarcity of evidence on the effect of the double burden posed by paid work and child care on the risk of CHD in women, main purpose of this study was to examine this relationship in a large Italian urban population, using number of children in the household as a proxy measure of child care. This study took into account also the sex of the offspring, in the light of the observed differences in terms of participation in domestic activities between sons and daughters in Italy (Romano, 2012).

2. Materials and Methods

2.1. Data collection.

The study population was composed of all women 25-50 years old at 2001 census, resident in Turin and living alone or in nuclear families (with their partners), with or without children (n=109,358). Women living with people other than the partner or the children were excluded because of the uncertainty on their child care support in the household. For example, grandparents, uncles or aunts could be a burden or a resource for women in performing domestic work and child care, depending on their personal choices or their health status. Baseline information on demographics, marital status, family typology, presence and number of children in the household, employment status and educational level was drawn from 2001 census data. Records from census data were linked, by means of a shared unique identification number, with those of the Municipality Registry and through this, with the local archives of mortality (registry of all residents' deaths since 1970) and of hospital admissions (which include records of all residents in Piedmont admitted to a hospital in Italy since the 1980s, with a satisfactory level of completeness since 1996). As a significant proportion of individuals affected by acute coronary disease usually die before hospital admission, the outcome of the study was represented by a binary variable, where subjects affected by CHD were identified through either first hospitalization or death from CHD during the observation period 2002-2010, as done in other studies using secondary data (Silventoinen, Pankow, Jousilahti, Hu, & Tuomilehto, 2005; Netterstrøm, Kristensenb, & Sjølc, 2006). Women who underwent hospitalization for CHD from 1996 to the start of follow-up (January 1st 2002) were excluded from the study (n=94). During the follow-up period, eventual dates of emigration out of Turin or death were reconstructed. Each subject contributed to person-years from January 1st 2002 until emigration, death, first hospital admission for CHD or end of follow-up (December 31st 2010).

CHD admissions and deaths were identified in the corresponding archives through the presence of ICD-IX codes 410-414 in the field of main diagnosis: acute myocardial infarction (n=170), other acute and subacute forms of coronary heart disease (n=71), previous infarction (n=1), angina pectoris (n=79) and other forms of chronic ischemic heart disease (n=27).

2.2. Analysis

CHD risk was estimated by multivariate Poisson regression models, stratified by employment status (employed or non-employed) and adjusted for age (5-year groups), marital status (married or cohabiting; unmarried; previously married, including separated, divorced and widowed) and education level (primary, secondary, higher and graduate education). The analysis was stratified by employment status, after checking by test for interaction that the risk of CHD associated with having children in the household was significantly different between employed and non-employed women (test for interaction: p=0.03). The relationship between CHD incidence and child care was assessed by operationalizing the workload linked to child care in different ways: 1) number of children in the household (continuous), overall and by sex; 2) combinations of number and sex of children in the household (one son, one daughter, one son and one daughter, >= 2 sons, >=2 daughters, >=2 sons and >=2 daughters); 3) cumulative age of children in the household, computed as the sum of the age of all children at 2001 census, also distinguished by sex, as a proxy indicator of cumulative dose of child care. In multivariate Poisson regression models, all risk estimates for a given sex of the children (e.g. male) were also adjusted for the presence (or number) of children of the opposite sex.

The association between CHD risk and cumulative age of the children was examined treating the latter either as a continuous or a categorical variable (up to 14 years, 15-29 years, 30 years or more). Furthermore, given that the effects of the double burden are expected to be stronger in women who work long hours, a test for interaction between presence of children in the household and number of working hours per week on CHD risk was also performed.

3. Results

3.1. Descriptive statistics

In Table 1 are presented descriptive statistics of the study population (age, place of birth, marital status and education level, by employment status and presence of children in the household), as well as CHD incidence in the different groups. At start of follow-up almost 4 out of 5 women were employed (78% of total population) and 60% of these had at least one child. The whole population of employed women used to work on average 34.7 hours per week, with those with children working less hours than those without children (33.5 vs. 36.4 hours per week, respectively).

With regard to the outcome variable, about 3 out of 1,000 women had undergone hospitalization (n=348) or had died (n=16) from CHD during the period 2002-2010, for a total of 364 women affected by CHD during the follow-up.

As expected, a positive trend in CHD incidence with increasing age was observed, with a strong increase in the age group 45-50 years at baseline (χ^2 p$\leq$ 0.001), consistently with the findings of other studies (Rosengren, Thelle, Köster, & Rosén, 2003).

About three quarters of the women were married or cohabiting (75%), 13% previously married (widowed, divorced or separated) and 12% unmarried, with strong differences related to employment status (χ^2 p$\leq$ 0.001) and presence of children in the household (χ^2 p$\leq$ 0.001).

Regarding education, more than half of women had a diploma (39%) or a university degree (19%). The educational level was markedly higher among employed women (χ^2 p$\leq$ 0.001) and among those without children (χ^2 p$\leq$ 0.001). CHD incidence decreased with increasing level of education and was five times higher in the lowest educational level, compared to the highest one. The only exception was the category of non-employed women with a university degree, whose high incidence (88.4 per 100,000) was however estimated on only two CHD cases.

TABLE 1. Frequency distribution of age, place of birth, marital status and education, by employment status, presence or not of children in the household, and CHD incidence per 100,000 person-years.

	Employed women				Non-employed women				Total	
	without children		with children		without children		with children			
	N	Annual CHD incidence	N	Annual CHD incidence	N	Annual CHD incidence	N	Annual CHD incidence	N	Annual CHD incidence
AGE										
25-29 years	7,016	3.8	2,420	5.4	493	27.2	1,504	17.3	**11,433**	**6.9**
row %	*61.4*		*21.2*		*4.3*		*13.2*		***100.0***	
col %	*20.6*		*4.7*		*13.4*		*7.4*		***10.5***	
30-34 years	9,217	4.1	8,343	5.9	617	21.0	3,095	16.0	**21,272**	**7.0**
row %	*43.3*		*39.2*		*2.9*		*14.5*		***100.0***	
col %	*27.1*		*16.2*		*16.8*		*15.3*		***19.5***	
35-39 years	6,756	1.8	13,297	15.2	545	23.0	4,323	24.9	**24,921**	**13.5**
row %	*27.1*		*53.4*		*2.2*		*17.3*		***100.0***	
col %	*19.9*		*25.8*		*14.8*		*21.4*		***22.8***	
40-44 years	4,973	31.2	13,550	37.8	564	21.7	4,743	66.9	**23,830**	**41.9**
row %	*20.9*		*56.9*		*2.4*		*19.9*		***100.0***	
col %	*14.6*		*26.3*		*15.3*		*23.5*		***21.8***	
45-50 years	6,028	90.9	13,879	102.2	1,467	108.7	6,528	93.5	**27,902**	**98.1**
row %	*21.6*		*49.7*		*5.3*		*23.4*		***100.0***	
col %	*17.7*		*27.0*		*39.8*		*32.3*		***25.5***	
PLACE OF BIRTH										
Italy	31,388	24.5	48,599	43.7	3,161	59.5	18,005	61.1	**101,153**	**41.5**
row %	*31.0*		*48.0*		*3.1*		*17.8*		***100.0***	

col %	*92.3*		*94.4*		*85.8*		*89.2*		***92.5***	
Abroad	2,602	14.6	2,890	37.4	525	48.5	2,188	11.1	**8,205**	**23.9**
row %	*31.7*		*35.2*		*6.4*		*26.7*		***100.0***	
col %	*7.7*		*5.6*		*14.2*		*10.8*		***7.5***	
MARITAL STATUS										
married	18,039	22.6	43,525	40.5	3,244	46.3	19,302	54.0	**84,110**	**40.1**
row %	*21.4*		*51.7*		*3.9*		*22.9*		***100.0***	
col %	*53.1*		*84.5*		*88.0*		*95.9*		***76.9***	
previously married	4,296	29.1	6,492	66.2	260	197.7	758	78.6	**11,806**	**56.6**
row %	*36.4*		*55.0*		*2.2*		*6.4*		***100.0***	
col %	*12.6*		*12.6*		*7.1*		*3.8*		***10.8***	
unmarried	11,655	23.5	1,472	24.8	182	70.8	133	190.6	**13,442**	**25.9**
row %	*86.7*		*11.0*		*1.4*		*1.0*		***100.0***	
col %	*34.3*		*2.9*		*4.9*		*0.7*		***12.3***	
EDUCATION										
no school or elementary school	935	9.1	2,924	149.1	694	125.5	4,144	100.3	**8,697**	**117.9**
row %	*10.8*		*33.6*	*8.0*	*8.0*		*47.6*		***100.0***	
col %	*2.8*		*5.7*	*18.8*	*18.8*		*20.5*		***8.0***	
middle school	7,767	35.5	17,800	45.7	1,671	44.9	9,759	50.6	**36,997**	**44.9**
row %	*21.0*		*48.1*		*4.5*		*26.4*		***100.0***	
col %	*22.9*		*34.6*		*45.3*		*48.3*		***33.8***	
high school	15,704	20.6	21,092	33.2	1,036	24.6	5,005	38.3	**42,837**	**29.1**
row %	*36.7*		*49.2*		*2.4*		*11.7*		***100.0***	
col %	*46.2*		*41.0*		*28.1*		*24.8*		***39.2***	

graduation	9,584	12.8	9,673	29.1	285	88.4	1,285	18.4	**20,827**	**21.9**
row %	*46.0*		*46.4*		*1.4*		*6.2*		***100.0***	
col %	*28.2*		*18.8*		*7.7*		*6.4*		***19.0***	
Total	**33,990**	**23.7**	**51,489**	**43.3**	**3,686**	**57.9**	**20,193**	**55.8**	**109,358**	**40.2**
row %	***31.1***		***47.1***		***3.4***		***18.5***		***100.0***	
col %	***100.0***		***100.0***		***100.0***		***100.0***		***100.0***	

Frequency distribution of number and gender of children in the household by employment status is presented in table 2: 17.5% of women had 1 son, 16% 1 daughter, 14% 1 son and 1 daughter, 9.8% 2 or more sons, 8% 2 or more daughters and 0.2% (227 women) 2 or more sons and 2 or more daughters. Age-adjusted CHD incidence was higher among non-employed than among employed ones, overall and in most exposure categories. In particular, among women with two or more sons in the household, a very high CHD incidence was observed among those employed (79.8), which was almost the double of the incidence of the non-employed (55.5). An exceptionally high CHD incidence was also observed among employed women with two or more sons and two or more daughters (261.4), although computed on a very small population (n=88), with only two exposed cases.

TABLE 2. Frequency distribution of the combinations of children in the household by employment status, CHD events, CHD incidence per 100,000 person-years and Incidence Rate Ratio (IRR) of CHD adjusted for age[a].

		employed women					non-employed women				
		N	CHD events	Annual CHD incidence	IRR[a]	95% CI[a]	N	CHD events	Annual CHD incidence	IRR[a]	95% CI[a]
without children		33,866	64	23.4	1		3,666	17	58.3	1	
	col %	39.6	25.3				15.4	15.3			
1 son		14,638	47	38.3	1.11	0.76-1.62	4,585	22	58.2	0.99	0.52-1.86
	col %	17.1	18.6				19.2	19.8			
1 daughter		13,576	42	36.9	1.15	0.77-1.70	3,909	19	58.2	1.05	0.55-2.02
	col %	15.9	16.6				16.4	17.1			
1 son and 1 daughter		10,554	31	34.6	1.01	0.65-1.55	4,796	25	62.3	1.12	0.60-2.09
	col %	12.3	12.3				20.1	22.5			
>= 2 sons		6,939	47	79.8	2.24	1.53-3.28	3,864	18	55.5	0.96	0.49-1.86
	col %	8.1	18.6				16.2	16.2			
>= 2 daughters		5,818	20	40.5	1.21	0.73-2.01	2,920	10	40.7	0.76	0.35-1.67
	col %	6.8	7.9				12.2	9.0			
>= 2 sons and >= 2 daughters		88	2	261.4	7.77	1.90-31.78	139	0	-	-	-
	col %	0.1	0.8				0.6	0.0			
Total		85,479	253	35.7	0.79	0.63-0.99	23,879	111	56.1	1	-
	col %	100.0	100.0				100.0	100.0			

[a] age in five years classes.

3.2. Presence of children in the household and CHD risk among women

The risk of CHD among employed women was similar to that of non-employed women, after controlling for age, education and marital status (IRR=0.98, 95% CI=0.76-1.24). In the overall population, the presence of children increased the risk of CHD significantly by 18% for each child (IRR=1.18, 95% CI=1.04-1.33), although the risk was significantly different between employed (IRR=1.29, 95% CI=1.11-1.49) and non-employed women (IRR=0.96, 95% CI=0.78-1.19).

Distinguishing number of children by sex (Table 2, model II), in the whole population CHD risk increased significantly by 24% for each son (IRR=1.24, 95% CI=1.07-1.43), whereas the increase in risk was smaller and non-significant for daughters in the household (IRR=1.11, 95% CI=0.95-1.30 for each daughter). The CHD risk associated with sons was significantly modified by employment status (test for interaction: p=0.02), with a significant increase among employed women (IRR=1.39, 95% CI=1.17-1.66) and a risk below unity for non-employed ones (IRR=0.96, 95% CI=0.74-1.23). Also examining the effect on CHD risk for the combination of number and sex of children, a significant interaction was found between employment and having two or more sons in the household (p=0.03); the associated risk was in fact significantly increased among employed women (IRR=2.23, 95% CI=1.48-3.36), but close to unity among non-employed ones (IRR=0.99, 95% CI=0.50-1.96) (Table 2, model III). In contrast, no significant association was found in either group for having one child, independently of the sex, or two children of opposite sex, or two or more daughters. However, a very high risk was found for women with two or more sons and two or more daughters, although based on only two exposed cases (IRR=8.29, 95% CI=2.01-34.23).

With respect to marital status, only among previously married women the interaction between employment and presence (yes/no) of children in the household (p=0.02) was statistically significant (among married women: p=0.94; among unmarried women: p=0.27). However, the risk of CHD associated with having two or more sons was, among employed married women, only slightly lower than that estimated among employed women as a whole (IRR=1.93, 95% CI=1.21-3.10). The risk was markedly higher among previously married women (IRR=5.11, 95% CI=2.01-12.96; 9 exposed cases), whereas no exposed cases were present among unmarried women. In the whole population, a significantly increased risk was observed among women exposed to a cumulative age of sons >=30 years (IRR=1.66, 95% CI=1.16-2.36), but again with a striking difference between employed (IRR= 2.28, 95% CI=1.50-3.46) and non-employed women (IRR=0.87, 95% CI=0.45-1.70) (test for interaction: p=0.004). In contrast, no significant excess risk was present in any category of cumulative exposure to daughters' care, independently of employment status.

Regarding working hours, no significant interaction was found among employed women between working hours and number of children in the household (p=0.48), independently of their gender (sons: p=0.47; daughters: p=0.06). Similarly, the interaction between working hours and the different combinations of children by gender (model III) was not statistically significant (p=0.27).

TABLE 3. Incidence Rate Ratio (IRR) of CHD associated with children in the household (also distinguished by gender) (models I-III) and with sons' and daughters' cumulated age (model IV) – Poisson regression models stratified by employment status and adjusted for age[a], education[b] place of birth[c] and marital status[d].

		employed women			non-employed women		
		N (CHD events)	**IRR**	**95% CI**	**N (CHD events)**	**IRR**	**95% CI**
Model I	**number of children[e]**	51,613 (189)	1.29	1.11-1.49	20,213 (94)	0.96	0.78-1.19
Model II	**number of sons[e]**	33,082 (133)	1.39	1.17-1.66	14,091 (65)	0.96	0.74-1.23
	number of daughters[e]	31,012 (107)	1.16	0.95-1.42	12,536 (57)	0.97	0.73-1.27
Model III	**without children**	33,866 (64)	1		3,666 (17)	1	
	1 son	14,638 (47)	1.11	0.75-1.66	4,585 (22)	1.03	0.54-1.96
	1 daughter	13,576 (42)	1.17	0.78-1.76	3,909 (19)	1.13	0.58-2.19
	1 son and 1 daughter	10,554 (31)	1.03	0.65-1.63	4,796 (25)	1.19	0.63-2.24
	>= 2 sons	6,939 (47)	2.23	1.48-3.36	3,864 (18)	0.99	0.50-1.96
	>= 2 daughters	5,818 (20)	1.27	0.75-2.15	2,920 (10)	0.81	0.37-1.80
	>= 2 sons and >= 2 daughters	88 (2)	8.29	2.01-34.23	139 (0)	-	-
Model IV	**cumulated age of sons (0-14 years)[e]**	19,138 (24)	0.74	0.47-1.17	6,724 (18)	1.02	0.57-1.83
	cumulated age of sons (15-29 years)[e]	11,303 (73)	1.41	1.03-1.91	5,447 (35)	1	0.64-1.59
	cumulated age of sons (over 30 years)[e]	2,641 (33)	2.28	1.50-3.46	1,920 (12)	0.87	0.45-1.70
	cumulated age of daughters (0-14 years)[e]	18,855 (41)	1.37	0.95-1.98	6,462 (13)	0.69	0.36-1.30
	cumulated age of daughters (15-29 years)[e]	10,239 (55)	1.07	0.77-1.48	4,898 (34)	1.13	0.72-1.76
	cumulated age of daughters (over 30 years)[e]	1,918 (11)	1.14	0.61-2.15	1,176 (10)	1.29	0.63-2.60

[a] age in five years classes.
[b] education in 4 classes: no school or elementary school, middle school, high school and graduation.
[c] place of birth in 2 classes: Italy and abroad.
[d] marital status in 3 classes: unmarried, married and previously married (separated, divorced and widowed).
[e] continuous variable

4. Discussion

The present study showed a significant relationship between CHD risk and the double burden posed by combining paid work and child care among women in Turin. While among non-employed women the presence of children did not increase the risk of CHD, among those employed the risk increased by 29% for each child. This association between such an overburden and incidence of CHD is consistent with the only two studies on the subject in the literature (Haynes & Feinleib, 1980; Lee et al., 2003). In both studies, in fact, intensive child care was associated with an increased CHD risk among employed women, although the risk estimates were marginally or not statistically significant.

With respect to the studies cited above, the most original aspect of our research was that the risk of CHD was assessed according to the sex of the offspring; the results showed that only the presence of two or more sons in the household increased the risk of developing CHD.

Parity has been found associated with an increased risk of CHD or cardiovascular diseases (CVD) in several studies, although the two main articles reviewing the available evidence on the subject got to opposite conclusions (Ness, Schotland, Flegal, & Shofer, 1994; De Kleijn, Van der Schouw, & Van der Graaf, 1999). However, the results of more recent studies would indicate that CHD risk is actually higher among women with children than among nulliparous (Lawlor et al., 2003; Catov et al., 2008; Parikh et al., 2010). From a biological point of view, the finding of an increased CHD risk limited to women with male children could, in theory, be explained by higher intrauterine growth (Hindmarsh, Geary, Rodeck, Kingdom, & Cole, 2002) and greater weight of male foetuses compared to female ones (Maršál et al., 1996) which would involve higher energy expenditure during sons' than daughter's pregnancies

(Tamimi et al., 2003). However, differences observed between sexes in these parameters are likely too small to exert a negative influence on women's health (Maršál et al., 1996).

Number of children has also been found positively associated with several risk factors for CHD, such as metabolic syndrome (Catov, 2008), hypertension (Brisson et al., 1999; Zimmerman & Hartley, 1982), high levels of triglycerides and low HDL cholesterol levels (Catov, 2008), high BMI (Lawlor, 2003; Hardy, Lawlor, Black, Wadsworth, & Kuh, 2007), increased tone of the sympathetic nervous system (Eller, Kristiansen, & Hansen, 2011) and diabetes mellitus type II (Hardy et al., 2007). Therefore, these CVD risk factors have been proposed as possible mediators of parity on CHD risk, but no studies, to our knowledge, reported differences related to the sex of the offspring in these intermediate outcomes.

With regard to socio-cultural factors, the association between the presence of male children in the household and the risk of developing CHD could be explained in the light of the results of the Italian Survey on the Time Use 2002-2003, showing that in Italy female children are more engaged in domestic work than male ones. The gap starts to be relevant in the age group 11-17 years, in which the proportion of females engaged in domestic activities is almost 50% higher than that of males (65% vs. 44%) and the time spent per day is about the double for females than males (44 vs. 22 minutes) (Romano, 2012). Such a difference between offspring gender in term of domestic activities appears consistent with the observation that CHD risk was associated with cumulative exposure to sons child care only in higher class of exposure (15-29 years and >=30 years), which suggests a chronic effect of exposure to the "double burden" on CHD risk.

Another possible explanation of the different CHD risk among employed women by the sex of their children comes from the results of Italian Health Behaviour in Shool-aged Children (HBSC) international survey, promoted by the World Health Organization. These findings showed some gender differences, with higher frequencies in males, with respect to the abuse of alcohol and cannabis (Cavallo et al., 2013). Therefore, employed women may be overburdened by the combination of working outside the household for many hours and responsibilities and concerns due to the deviant behaviour of their adolescent sons.

Although no study investigated women's CHD risk by sex of the offspring, a few focused on the relationship between children's sex and women's longevity or mortality; however, most of these studies were conducted in pre-industrial or traditional developing societies, which limits their generalizability to developed contemporary ones (Helle, Lummaa, & Jokela, 2002; Van de Putte, Matthijs, & Vlietinck, 2004; Hurt, Ronsmans, & Quigley, 2006). Some of them found an increased risk of mortality associated with the number of sons, but not of daughters (Helle et al., 2002; Van de Putte et al., 2004; Hurt et al., 2006), although other studies did not find significant differences in mortality by sex of the offspring (Jasienska, Nenko, & Jasienski, 2006; Cesarini, Lindqvist, & Wallace, 2007).

These findings suggest that the association between parity and CHD risk is more likely attributable to the physical and mental workload associated with child-rearing, rather than to biological factors related to pregnancy. The higher risk observed among previously married women, compared to married ones, would also support a causal relationship between child care burden and the CHD occurrence, given the higher burden expected among these women, who need to provide child care without partner's support.

The results of the present study, however, should be interpreted in the light of some limitations in the study design and methods. First of all, it was not possible to control for several potential confounders or mediators of the association between double burden and CHD, such as BMI, diabetes, smoking, alcohol and physical inactivity, all CHD risk factors potentially correlated with parity, since these data were not available at census. Nonetheless, given that the increase in CHD risk was limited to employed women with male children, it does not seem plausible that the observed association was attributable to lack of adjustment for these variables, unless their prevalence was different between employed women with male and female children. For example, a higher BMI among employed women with children may have confounded the relationship between number of children and CHD incidence, but only a higher BMI among employed women with sons, compared to those with daughters, would explain the specificity of the association with male offspring. To answer this question, we analyzed data from the National Health Interview 2005 on physical activity, BMI, and smoking, restricting the analysis to women 25-50 years old living in Northern Italy (N=7,021). In this survey, very small differences were found in average BMI (χ^2 p=0.99), or in the proportion of women performing physical activity (χ^2 p=0.88) or smoking (χ^2 p=0.88), by number or sex of the children living in the household (personal elaboration of the authors).

Another limitation concerns the possible misclassification of the number of children and the professional status of the women enrolled, deriving from the impossibility of detecting newborn children (and therefore also the change in the condition of mother), as well as changes in employment status during the follow-up period. Therefore, it was assumed that during the follow-up the number of children remained constant and that the professional status of women did not change, with the expected consequence of a non-differential misclassification of exposure to these factors and an underestimate of the associated relative risks. Similarly, lack of information on women's employment status before 2001 census could have led to identify as non-employed also women who have worked just until before 2001 census, and vice versa, making uncertain the duration of combined exposure to paid work and child care.

With regard to the employment status of women, the absence of work stress indicators in the available databases could represent a significant information bias. Recent reviews on the relationship between exposure to psychosocial factors at work and CHD incidence have confirmed the presence of a significant excess risk associated with exposure to stress defined according to the two most popular models (Kivimäki, Nyberg, & Batty, 2012; Siegrist, 2010), i.e. the demand-control (Karasek, 1979) and the effort-reward imbalance model (Siegrist, 1996). It is therefore expected that the effect of the double burden of employed women on CHD risk would be theoretically higher for women exposed to stress factors at work. For example, using the demand-control model, Brisson et al. (1999) observed a significant increase in blood pressure only among employed women exposed to both high job strain and high household workload, whereas the increase was lower and not significant among women exposed to high levels of only one of these factors.

In conclusion, this study found a significantly increased risk of CHD associated with the presence of children in the household among employed women, which was limited to women with two or more male children, whereas no association was present among non-employed women. This is a new finding, which should be confirmed in other studies conducted also in countries where the division of domestic (and specifically child care) duties between males and females is more balanced, such as the European Nordic countries (Francavilla, Gianelli, Mangiavacchi, & Piccoli, 2013). In fact, the generalizability of the results of the present study may be limited by the peculiarities of the Italian traditional family model, which tends to overload the female gender with most of the burden of domestic responsibilities.

Our results suggest the need to foster social discussion in Italy on the distribution of household duties and child care activities, which may help to go beyond the Italian "traditional" family model. The repetition of similar research in countries with a more gendered equitable division of the domestic work and child care, such as Nordic countries, may help clarifying the mechanism through which employed women with sons are at higher risk of CHD. The eventual persistence of such a strong association in these countries would suggest that it may be attributable to other characteristics differentiating sons and daughters, rather than the extent of their domestic work; for example, a more deviant behavior of sons than daughters, made even more stressful and problematic for the working mothers by their engagement for many hours per day outside the family.

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TABLE 1. Frequency distribution of age, place of birth, marital status and education, by employment status, presence or not of children in the household, and CHD incidence per 100,000 person-years.

	Employed women				Non-employed women				Total	
	without children		with children		without children		with children			
	N	Annual CHD incidence	N	Annual CHD incidence	N	Annual CHD incidence	N	Annual CHD incidence	N	Annual CHD incidence
AGE										
25-29 years	7,016	3.8	2,420	5.4	493	27.2	1,504	17.3	**11,433**	**6.9**
row %	*61.4*		*21.2*		*4.3*		*13.2*		***100.0***	
col %	*20.6*		*4.7*		*13.4*		*7.4*		***10.5***	
30-34 years	9,217	4.1	8,343	5.9	617	21.0	3,095	16.0	**21,272**	**7.0**
row %	*43.3*		*39.2*		*2.9*		*14.5*		***100.0***	
col %	*27.1*		*16.2*		*16.8*		*15.3*		***19.5***	
35-39 years	6,756	1.8	13,297	15.2	545	23.0	4,323	24.9	**24,921**	**13.5**
row %	*27.1*		*53.4*		*2.2*		*17.3*		***100.0***	
col %	*19.9*		*25.8*		*14.8*		*21.4*		***22.8***	
40-44 years	4,973	31.2	13,550	37.8	564	21.7	4,743	66.9	**23,830**	**41.9**
row %	*20.9*		*56.9*		*2.4*		*19.9*		***100.0***	
col %	*14.6*		*26.3*		*15.3*		*23.5*		***21.8***	
45-50 years	6,028	90.9	13,879	102.2	1,467	108.7	6,528	93.5	**27,902**	**98.1**
row %	*21.6*		*49.7*		*5.3*		*23.4*		***100.0***	
col %	*17.7*		*27.0*		*39.8*		*32.3*		***25.5***	
PLACE OF BIRTH										
Italy	31,388	24.5	48,599	43.7	3,161	59.5	18,005	61.1	**101,153**	**41.5**
row %	*31.0*		*48.0*		*3.1*		*17.8*		***100.0***	

col %	*92.3*		*94.4*		*85.8*		*89.2*		***92.5***	
Abroad	2,602	14.6	2,890	37.4	525	48.5	2,188	11.1	**8,205**	**23.9**
row %	*31.7*		*35.2*		*6.4*		*26.7*		***100.0***	
col %	*7.7*		*5.6*		*14.2*		*10.8*		***7.5***	
MARITAL STATUS										
married	18,039	22.6	43,525	40.5	3,244	46.3	19,302	54.0	**84,110**	**40.1**
row %	*21.4*		*51.7*		*3.9*		*22.9*		***100.0***	
col %	*53.1*		*84.5*		*88.0*		*95.9*		***76.9***	
previously married	4,296	29.1	6,492	66.2	260	197.7	758	78.6	**11,806**	**56.6**
row %	*36.4*		*55.0*		*2.2*		*6.4*		***100.0***	
col %	*12.6*		*12.6*		*7.1*		*3.8*		***10.8***	
unmarried	11,655	23.5	1,472	24.8	182	70.8	133	190.6	**13,442**	**25.9**
row %	*86.7*		*11.0*		*1.4*		*1.0*		***100.0***	
col %	*34.3*		*2.9*		*4.9*		*0.7*		***12.3***	
EDUCATION										
no school or elementary school	935	9.1	2,924	149.1	694	125.5	4,144	100.3	**8,697**	**117.9**
row %	*10.8*		*33.6*	*8.0*	*8.0*		*47.6*		***100.0***	
col %	*2.8*		*5.7*	*18.8*	*18.8*		*20.5*		***8.0***	
middle school	7,767	35.5	17,800	45.7	1,671	44.9	9,759	50.6	**36,997**	**44.9**
row %	*21.0*		*48.1*		*4.5*		*26.4*		***100.0***	
col %	*22.9*		*34.6*		*45.3*		*48.3*		***33.8***	
high school	15,704	20.6	21,092	33.2	1,036	24.6	5,005	38.3	**42,837**	**29.1**
row %	*36.7*		*49.2*		*2.4*		*11.7*		***100.0***	
col %	*46.2*		*41.0*		*28.1*		*24.8*		***39.2***	

graduation	9,584	12.8	9,673	29.1	285	88.4	1,285	18.4	**20,827**	**21.9**
row %	*46.0*		*46.4*		*1.4*		*6.2*		***100.0***	
col %	*28.2*		*18.8*		*7.7*		*6.4*		***19.0***	
Total	**33,990**	**23.7**	**51,489**	**43.3**	**3,686**	**57.9**	**20,193**	**55.8**	**109,358**	**40.2**
row %	***31.1***		***47.1***		***3.4***		***18.5***		***100.0***	
col %	***100.0***		***100.0***		***100.0***		***100.0***		***100.0***	

TABLE 2. Frequency distribution of the combinations of children in the household by employment status, CHD events, CHD incidence per 100,000 person-years and Incidence Rate Ratio (IRR) of CHD adjusted for age[a].

	employed women					non-employed women				
	N	CHD events	Annual CHD incidence	IRR[a]	95% CI[a]	N	CHD events	Annual CHD incidence	IRR[a]	95% CI[a]
without children	33,866	64	23.4	1		3,666	17	58.3	1	
col %	39.6	25.3				15.4	15.3			
1 son	14,638	47	38.3	1.11	0.76-1.62	4,585	22	58.2	0.99	0.52-1.86
col %	17.1	18.6				19.2	19.8			
1 daughter	13,576	42	36.9	1.15	0.77-1.70	3,909	19	58.2	1.05	0.55-2.02
col %	15.9	16.6				16.4	17.1			
1 son and 1 daughter	10,554	31	34.6	1.01	0.65-1.55	4,796	25	62.3	1.12	0.60-2.09
col %	12.3	12.3				20.1	22.5			
>= 2 sons	6,939	47	79.8	2.24	1.53-3.28	3,864	18	55.5	0.96	0.49-1.86
col %	8.1	18.6				16.2	16.2			
>= 2 daughters	5,818	20	40.5	1.21	0.73-2.01	2,920	10	40.7	0.76	0.35-1.67
col %	6.8	7.9				12.2	9.0			
>= 2 sons and >= 2 daughters	88	2	261.4	7.77	1.90-31.78	139	0	-	-	-
col %	0.1	0.8				0.6	0.0			
Total	85,479	253	35.7	0.79	0.63-0.99	23,879	111	56.1	1	-
col %	100.0	100.0				100.0	100.0			

[a] age in five years classes.

TABLE 3. Incidence Rate Ratio (IRR) of CHD associated with children in the household (also distinguished by gender) (models I-III) and with sons' and daughters' cumulated age (model IV) – Poisson regression models stratified by employment status and adjusted for age[a], education[b] place of birth[c] and marital status[d].

		employed women			non-employed women		
		N (CHD events)	**IRR**	**95% CI**	**N (CHD events)**	**IRR**	**95% CI**
Model I	**number of children**[e]	51,613 (189)	1.29	1.11-1.49	20,213 (94)	0.96	0.78-1.19
Model II	**number of sons**[e]	33,082 (133)	1.39	1.17-1.66	14,091 (65)	0.96	0.74-1.23
	number of daughters[e]	31,012 (107)	1.16	0.95-1.42	12,536 (57)	0.97	0.73-1.27
Model III	**without children**	33,866 (64)	1		3,666 (17)	1	
	1 son	14,638 (47)	1.11	0.75-1.66	4,585 (22)	1.03	0.54-1.96
	1 daughter	13,576 (42)	1.17	0.78-1.76	3,909 (19)	1.13	0.58-2.19
	1 son and 1 daughter	10,554 (31)	1.03	0.65-1.63	4,796 (25)	1.19	0.63-2.24
	>= 2 sons	6,939 (47)	2.23	1.48-3.36	3,864 (18)	0.99	0.50-1.96
	>= 2 daughters	5,818 (20)	1.27	0.75-2.15	2,920 (10)	0.81	0.37-1.80
	>= 2 sons and >= 2 daughters	88 (2)	8.29	2.01-34.23	139 (0)	-	-
Model IV	**cumulated age of sons (0-14 years)**[e]	19,138 (24)	0.74	0.47-1.17	6,724 (18)	1.02	0.57-1.83
	cumulated age of sons (15-29 years)[e]	11,303 (73)	1.41	1.03-1.91	5,447 (35)	1	0.64-1.59
	cumulated age of sons (over 30 years)[e]	2,641 (33)	2.28	1.50-3.46	1,920 (12)	0.87	0.45-1.70
	cumulated age of daughters (0-14 years)[e]	18,855 (41)	1.37	0.95-1.98	6,462 (13)	0.69	0.36-1.30
	cumulated age of daughters (15-29 years)[e]	10,239 (55)	1.07	0.77-1.48	4,898 (34)	1.13	0.72-1.76
	cumulated age of daughters (over 30 years)[e]	1,918 (11)	1.14	0.61-2.15	1,176 (10)	1.29	0.63-2.60

[a] age in five years classes.
[b] education in 4 classes: no school or elementary school, middle school, high school and graduation.
[c] place of birth in 2 classes: Italy and abroad.
[d] marital status in 3 classes: unmarried, married and previously married (separated, divorced and widowed).
[e] continuous variable

HIGHLIGHTS:

1) retrospective study (2002-10) on women aged 25-50 years at baseline

2) CHD risk increased significantly by 18% for each child, only among employed women

3) having two or more sons doubled CHD risk, also only among employed women

4) no significant increase in CHD risk was present among women with daughters

5) results may be due to a gendered division of domestic work among Italian adolescents